

# **SDH86MB Micro-stepping Stepper Motor Driver**

## **User Manual**



## Features

- Output current up to 8.28 A
- Supply voltage up to +80VDC
- Up to 1/50 micro step resolution with 16 selectable micro step setup
- Increased torque at high speed
- Suitable for 2-phase and 4-phase step motors with peak current < 8.2A
- Dip switch to set 8 different current values
- Input pulse frequency up to 200kHz
- Optically isolated input signals
- Automatically standstill current reduction
- Over voltage, Over Current, Short Circuit protection
- Bipolar constant current chopping drive circuit

## Introduction

The SD2H86MB is a cost effective micro-stepping stepper motor driver based on new developed technology. It is suitable for driving 2-phase 4-phase hybrid stepping motors .By using the advanced bipolar constant-current shopping technique, it can output more torque at high speed from the same motor, compared with traditional drivers, such as L/R drivers. Its 3-state current control technology allows coil currents to be well controlled and with relatively small current ripple, therefore less motor heating is achieved.

## Specifications and Operating Environment

### Electrical Specifications (T<sub>j</sub>=25°C)

Parameters	SD2H86MB			
	Min	Typical	Max	Unit
Output current	1.82	-	8.28 (peak)	A
Supply voltage((DC)	20	68	80	VDC
Logic signal current	6	10	30	mA
Pulse input frequency	0	-	200	KHz
Isolation resistance	500			mΩ
Control signal input high	3.6	5	5.5	VDC
Control signal input low	-5.5	0	0.3	VDC

**Operating Environment and other Specifications**

Cooling	Natural Cooling or Forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0°C-50°C
	Humidity	40%RH-90%RH
	Operating Temperature	70°C Max
	Vibration	5.9m/s <sup>2</sup> Max
Storage Temperature	-20°C-65°C	
Weight	Approx 1000 gram (35.4oz)	

**Pin Assignment and Description**

The SD2H86MB has two connectors, connector P1 for control signals connections, and connector P2 for power and motor connections. The following tables are brief descriptions of the two connectors of the SD2H86MB. More Detailed descriptions of the pins and related issues are presented following sections.

**Connector P1 Configurations**

Pin Function	Details
PUL +,PUL-	Pulse input signal: In single pulse (pulse/direction) mode, this input represents pulse signal, effective for each rising or falling edge; For reliable response, pulse width should be longer than 5μs.
DIR+,DIR-	DIR signal: In pulse mode, this signal has low/high voltage levels, representing two directions of motor rotation; For reliable motion response, DIR signal should be ahead of PUL signal by 5μs at least.
ENA+	Enable signal: This signal is used for enabling/disabling the driver. High level for enabling the driver and low level for disabling the driver.
ENA-	Usually left unconnected (enabled)

**Connector P2 Configurations**

Pin Function	Details
Gnd	DC power ground
+V	DC power supply,20-80VDC,Including voltage fluctuation and EMF voltage
A+,A-	Motor Phase A
B+ B-,	Motor Phase B

## Applications

SD2H86MB is suitable for a wide range of stepper motors from Nema size 14 to Nema size 34, It can be used in various kinds of machines, such as numerical control machine, labeling machines, laser cutters, engraving machines, pick-place devices, and so on. Particularly adapt to the applications desired with low vibration, high speed and high precision.

## Selecting Supply Voltage

The power MOSEFTS inside the SD2H86MB can actually operate from 20V to +80VDC, including power input fluctuation and back EMF voltage generated by motor coils during motor shaft deceleration. Higher supply voltage can increase motor torque at higher speeds, thus helpful for avoiding losing steps. However higher voltage may cause bigger motor vibration at lower speed, and it may also cause over-voltage protection or even driver damage. Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications, and it is suggested to use power supplies with theoretical output voltage of +20V~+80V, leaving room for power fluctuation and back-EMF.

## Selecting Micro Step Resolution

This driver uses an 8-bit DIP switch to set micro step resolution and motor operating current, as shown in the table below:

**Micro Step resolution is set by SW 5,6,7,8 of the DIP switch as shown in the following table:**

Micro step mode	SW5	SW6	SW7	SW8	Micro step mode	SW5	SW6	SW7	SW8
1 / 2	On	On	On	On	1 / 12	On	On	On	Off
1 / 2.5	Off	On	On	On	1 / 16	Off	On	On	Off
1 / 3	On	Off	On	On	1 / 20	On	Off	On	Off
1 / 4	Off	Off	On	On	1 / 25	Off	Off	On	Off
1 / 5	On	On	Off	On	1 / 30	On	On	Off	Off
1 / 6	Off	On	Off	On	1 / 32	Off	On	Off	Off
1 / 8	On	Off	Off	On	1 / 40	On	Off	Off	Off
1 / 10	Off	Off	Off	On	1 / 50	Off	Off	Off	Off

## Driver Output Current Setting

For a given motor, higher driver current will make the motor to output more torque, but at the same time causes more heating in the motor and driver. Therefore output current is generally set to be such value that the motor will not overheat for long time operation. Since parallel and serial connections of motor coils will significantly change resulting inductance and resistance, it is important to set driver output current based on motor phase and connection methods. Phase current rating supplied by motor manufacturer is important in selecting driver current; however the selection also depends on leads and connections.

The first three bits (SW 1, 2, 3) of the DIP switch are used to set the dynamic current. Select a setting that is closest to the required current to your motor.

### Dynamic Current Setting

Peak current (A)	SW1	SW2	SW3
1.82A	Off	Off	Off
2.73A	On	Off	Off
3.63A	Off	On	Off
4.65A	On	On	Off
5.56A	Off	Off	On
4.46A	On	Off	On
7.37A	Off	On	On
8.28A	On	On	On

Notes: Due to motor inductance, the actual current in the coil may be smaller than the dynamic current setting, particularly under high speed condition.

### Standstill Current Setting

SW4 is used to set standstill current. OFF means that the standstill current is set to be half of the selected dynamic current and ON means that standstill is set to be the same as the selected dynamic current.

When SW4 is set OFF, the current automatically reduces to 50% of the selected dynamic current after 0.4 second of the last pulse. Theoretically, this will reduce motor heating up to 25% (due to  $P=I^2 \cdot R$ ) of the original value.

## Timing Chart of Control Signals

In order to avoid some fault operations and deviations. PUL, DIR and ENA signals must obey by some rules, as shown in the following diagram (assuming J1 default setting is upward-rising edge effective):

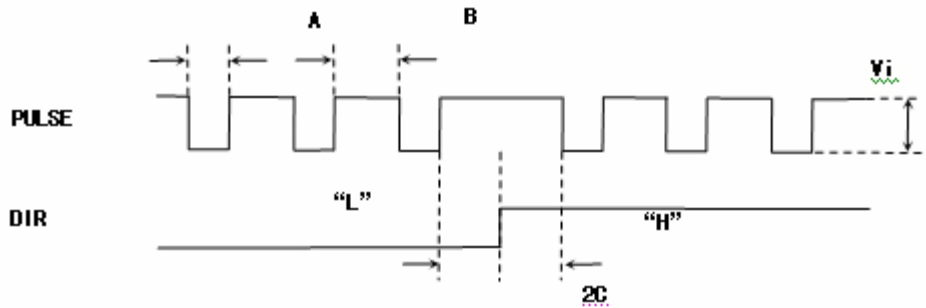


Figure 1 Sequence Chart of control signals

### Timing Specifications:

Pulse width (A, B in figure 1)  $\geq 2.5\mu s$ , pulse frequency  $\leq 200$  kHz.

Dir/ENA switching time (C in figure 1)  $\geq 2\mu s$

## Wiring Notes

In order to improve anti-interference performance of the driver, it is recommended to use twisted pair shield cable. To prevent noises incurring in PUL/DIR signal, pulse/direction signal wires and motor wires should not be tied up together. It is better to separate them by at least 10 cm away; otherwise the disturbing signals generated by motor will easily disturb pulse and direction signals, causing motor position error, system instability and other failures.

If a power supply serves several drivers, separately connecting the drivers is recommended instead of daisy-chaining. It is prohibited to pull and plug connector P2 while the driver is powered ON, because there is high current flowing through motor coils (even when motor is at standstill). Pulling or plugging connector P2 with power on will cause extremely high back-EMF voltage surge, which may damage the driver.

The SD2H86MB can accept differential and single-ended input signals (including open-collector and PNP output). The SD2H86MB has 3 optically isolated logic inputs which are located on connector P1 to accept control signals. These inputs are isolated to minimize electrical noises coupled onto the drive control signals. Recommend to use differential control signals to increase noise immunity of the driver in interference environments. Wiring diagram for open-collector and PNP signals are illustrated in the

following figures.

## NPN OPEN Collector SIGNALS CONNECTION:

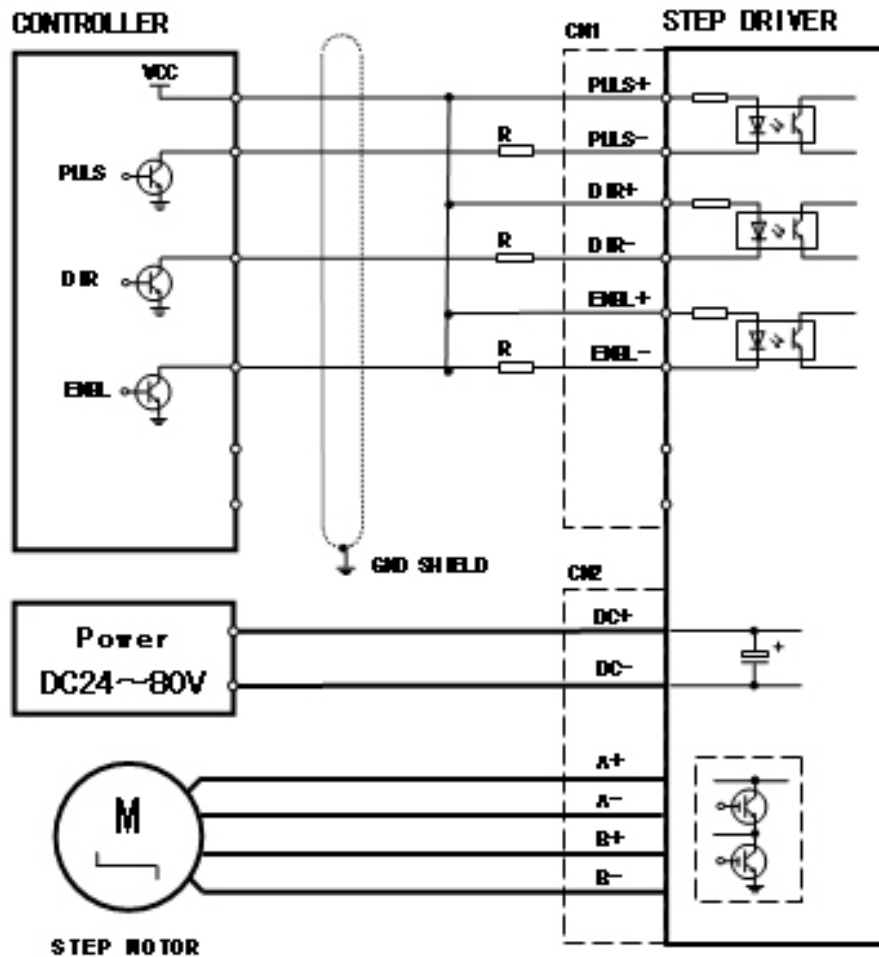


Figure 2 Connection to NPN open collector signals

### Attention:

- When  $V_{cc}=+5V$ ,  $R=0$
- When  $V_{cc}=+12V$ ,  $R=1k\Omega/0.25W$
- When  $V_{cc}=+24V$ ,  $R=2k\Omega/0.25W$
- It is recommended to use shielded cable for the cable from controller to driver. Shield is connector to ground.
- Choose power line or motor line with line diameter not less than 1mm.

## PNP C-E OPEN PULSE SIGNALS CONNECTION:

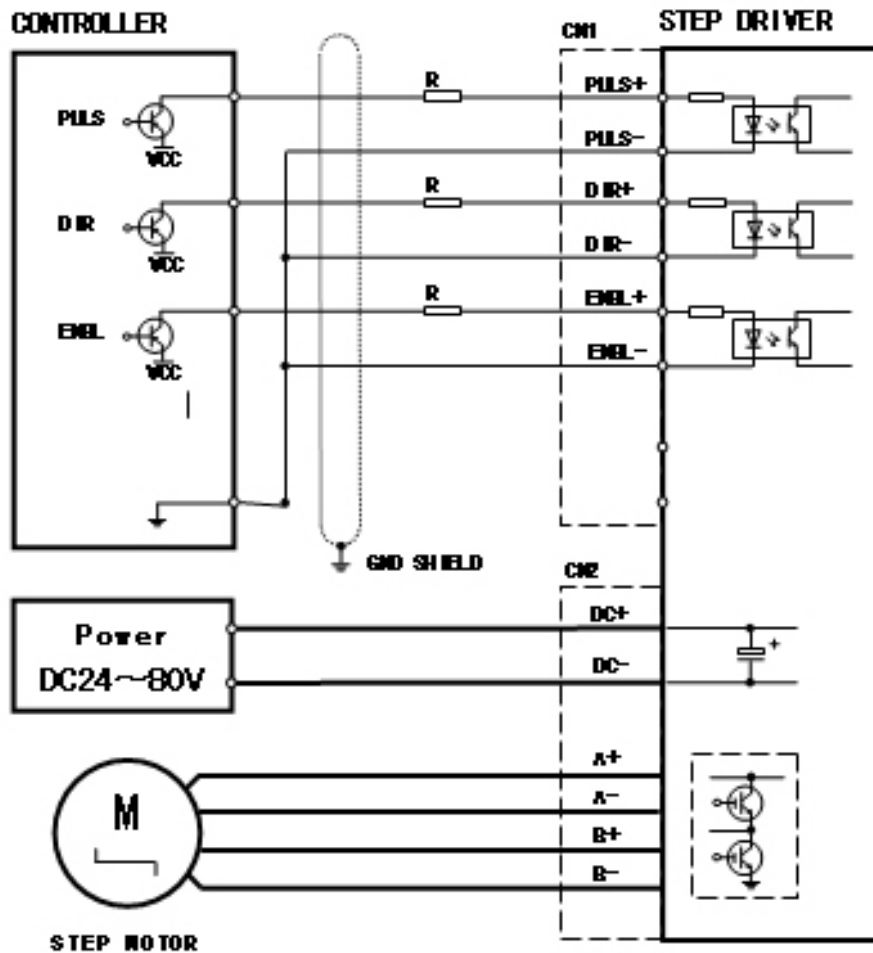


Figure 3 Connection to PNP open collector signals

### Attention:

- When  $V_{cc}=+5V$ ,  $R=0$
- When  $V_{cc}=+12V$ ,  $R=1k\Omega/0.25W$
- When  $V_{cc}=+24V$ ,  $R=2k\Omega/0.25W$
- It is recommended to use shielded cable for the cable from controller to driver. Shield is connector to ground.
- Choose power line or motor line with line diameter not less than 1mm.



## Differential driver control signals:

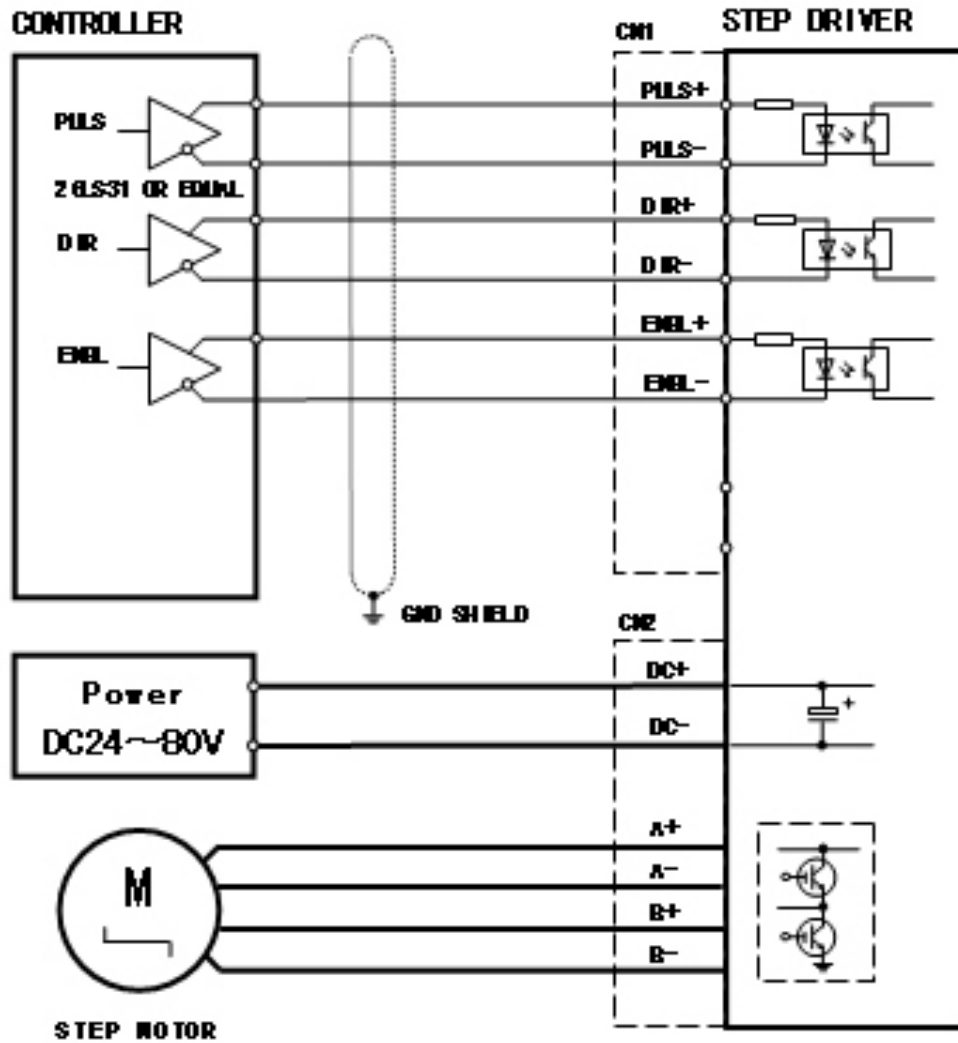


Figure 4 Connection to differential signals

## Attention:

- This is the recommended connection method
- 26LS31 or compatible IC can be selected as the differential driver chip
- It is recommended to use shielded cable for the cable from controller to driver. Shield is connector to ground.
- Choose power line or motor line with line diameter not less than 1mm.

## Mechanical Specifications (unit: inch)

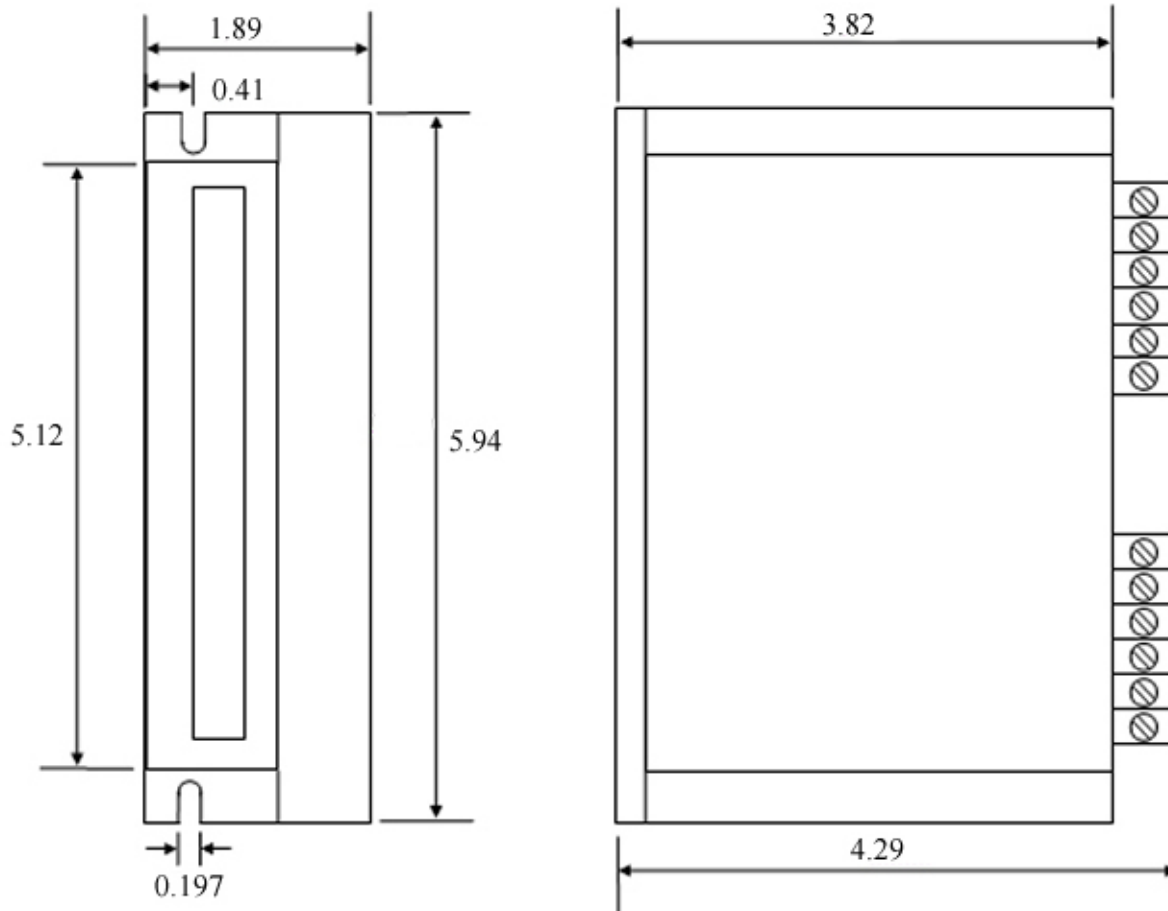


Figure 5 Mechanical Drawings

Note: It is recommended to use side mounting for better heat dissipation

## Motor connection

The SD2H86MB driver can drive any 2-pahse and 4-pahse Hybrid stepping motors.

### • Connections to 4-lead Motors

4 lead motors are the least flexible but easiest to wire. Speed and torque will depend on winding inductance. In setting the driver output current, multiply the motor rated current by 1.4 to determine the pack output current.

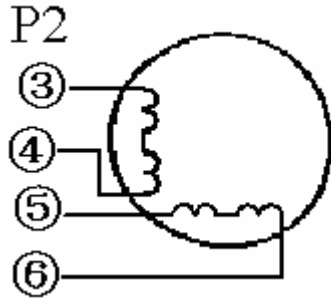


Figure 6 4-lead motor connections

• **Connections to 6-lead Motors**

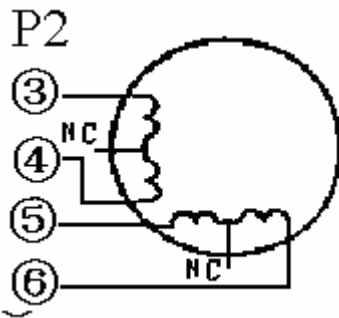


Figure 7 6-lead motors full coil connection

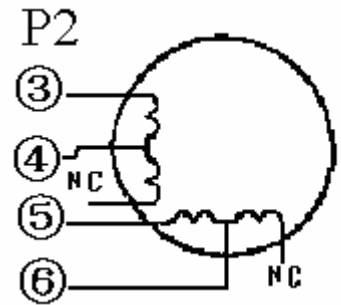


Figure 8 6-lead motors half coil connection

Like 8 lead stepping motors, 6 lead motors have two configurations available for high speed or high torque operation. The higher speed configuration, or half coil, is so described because it uses one half of the motor's inductor windings. The higher torque configuration, or full coil, uses the full windings of the phases.

**Half coil Configurations**

As previously stated, the half coil configuration uses 50% of the motor phase windings. This gives lower inductance, hence lower torque. Like the parallel connection of 8 lead motor, the torque output will be more stable at higher speeds. This configuration is also referred to as half chopper. In setting the driver output current multiply the rated current per phase (or unipolar) by 1.4 to determine the peak output current.

**Full Coil Configurations**

The full coil configuration on a six lead motor should be used in applications where higher torque at lower speeds is desired. This configuration is also referred to as full copper. In full coil mode, the motor should be run at only 70% of their rated current to prevent over heating.

### • Connections to 8-lead Motors

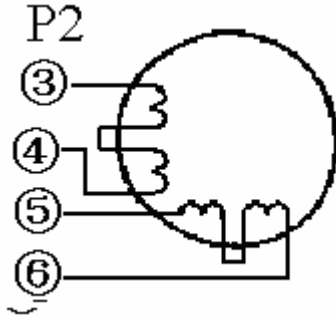


Figure 9 8-lead motor serial connections

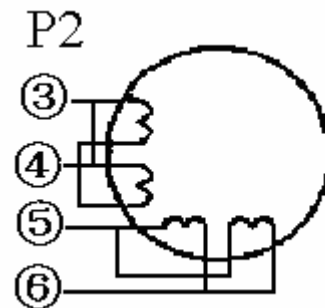


Figure 10 8-lead motor parallel connections

8 lead motors offer a high degree of flexibility to the system designer in that they may be connected in series or parallel, thus satisfying a wide range of applications.

### Series Connections

A Series motor configuration would typically be used in applications where a higher torque at lower speeds is required. Because this configuration has the most inductance, the performance will start to degrade at higher speeds. In series mode, the motors should also be run at only 70% of their rated current to prevent over heating.

### Parallel Connections

An 8 lead motor in a parallel configuration offers a staler but lower torque at higher speeds. But because of the lower inductance, there will be higher torque at higher speeds. Multiply the rated current per phase (or unipolar) by 1.96, or the bipolar current by 1.4, to determine the peak output current.

## Power Supply Selection

SD2H86MB can match medium and small size stepping motors (from Nema size 17 to 34). To achieve good driving performances, it is important to select correct power supply. Generally speaking, supply voltage determines the high speed performance of the motor, while output current determines the output torque of the driven motor (particularly at lower speed). Higher supply voltage will allow higher motor speed to be achieved, at the price of more noise and heating. If the motion speed requirement is low, it's better to use lower supply voltage to decrease noise, heating and improve reliability.

Both regulated and unregulated power supplies can be used to supply the driver. However, unregulated power supplies are preferred due to their ability to withstand current surge. If regulated power supplies (such as most switching supplies.) are used, it is important to have large current output rating to avoid

problems like current clamp, for example using 4A supply for 3A motor-driver operation.

On the other hand, if unregulated supply is used, we may use a power supply of lower current rating than that of motor (typically 50%~70% of motor current). The reason is that the driver draws current from the power supply capacitor of the unregulated supply only during the ON duration of the PWM cycle, but not during the OFF duration. Therefore, the average current withdrawn from power supply is considerably less than motor current. For example, two 3A motors can be well supplied by one power supply of 4A rating.

### **Multiple Drivers**

It is recommended to have multiple drivers to share one power supply to reduce cost, if the supply has enough capacity. To avoid cross interference, DO NOT daisy-chain the power supply input pins of the drivers. (Instead, please connect them to power supply separately.)

## **Protection Functions**

To improve reliability, the driver incorporates some built-in protection features.

### **• Over-voltage Protection**

When power supply voltage exceeds +85VDC, protection will be activated and power indicator LED will turn red.

### **• Coil-ground Short Circuit Protection**

Protection will be activated in case of short circuit between motor coil and ground.

Attention: Since there is no protection against power leads (+,-) reversal, it is critical to make sure that power supply leads correctly connected to the driver. Otherwise, the driver will be damaged instantly. When power supply voltage is lower than +20VDC, the driver will not work properly.